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EXAMINER

RASHID, DAVID

ART UNIT PAPER NUMBER

2609

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	03/26/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/807,187

Applicant(s)

MITSUI, TADASHI

Examiner

David P. Rashid

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 24 March 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date 3/24/2004, 9/23/2004, 2/9/2007.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: ____.

DETAILED ACTION

All of the examiner's suggestions presented herein below have been assumed for examination purposes, unless otherwise noted.

Priority

1. Acknowledgment is made of applicant's claim for foreign priority under 35 U.S.C. 119(a)-(d). The certified copy has been filed for Application No. 2003-83324, filed on 3/25/2003.

Drawings

2. The following is a quote from 37 CFR 1.84(p)(3):

When necessary, such as indicating a surface or cross section, a reference character may be underlined and a blank space may be left in the hatching or shading where the character occurs so that it appears distinct.

3. FIG. 1 is objected under 37 CFR 1.84(p)(3) for failing to properly use underlining – suggest deleting the underlining for reference numeral 10.

4. The following is a quote from 37 CFR 1.84(p)(4):

The same part of an invention appearing in more than one view of the drawing must always be designated by the same reference character, and the same reference character must never be used to designate different parts.

5. FIG. 14 and FIG. 15 are objected under 37 CFR 1.84(p)(4) for failing to use distinct reference characters for different parts. Though similar in concept, reference character's "Group 1" and "Group 2" of FIG. 14 and FIG. 15 are separate disclosed parts from that of the same

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reference character names in FIG. 9A through FIG. 10. “Group 1” and “Group 2” of FIG. 9A through FIG. 10 correlate with edge point areas of hole pattern P3 while the “Group 1” and “Group 2” of FIG. 14 and FIG. 14 correlate with the edge point areas of pattern P5 – suggest renaming “Group 1” and “Group 2” in both the drawing and specification for FIG. 14 and FIG. 15.

6. Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as “amended.” If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either “Replacement Sheet” or “New Sheet” pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

7. Applicant is reminded of the proper language and format for an abstract of the disclosure (it has been noted that the abstract for the application being examined is 196 words).

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

8. The disclosure is objected to because of the following informalities:

(i) page 2, line 10 contains a spelling error – suggest changing to "...to reproduce the pattern images...".

(ii) page 10, line 11 refers to the wrong reference numeral element – suggest changing to "..., a processor 14,...".

Appropriate correction is required.

Claim Objections

9. 37 CFR 1.75(a) reads as follows:

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The specification must conclude with a claim particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention or discovery.

10. Claims 2, 12 and 18 are objected to because of the following informalities:

(i) Claim 2, line 9 is unclear as to the phrase “integral multiples” and is not consistent with the previous elements – suggest changing to “integer multiples”.

(ii) Claim 12, line 1 refers to the wrong claim – suggest changing to “...according to claim 11,...”.

(iii) Claim 18, line 6 contains a grammatical error – suggest changing to “...an integer multiple of a predetermined...”.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

11. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

12. **Claims 1, 2, 4, 5, 11, 12, 14, 15, 17, and 19** are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination between Takane et al. (US 6,538,249) and Gleason et al. (US 6,456,899 B1).

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Regarding **claim 1**, while Takane discloses a pattern measuring apparatus (“[First embodiment] FIG. 3 is a diagram used to describe focus deviations which are a problem to be solved by the present invention.”, column 5, line 58) comprising:

a storage device which stores a plurality of pattern images of a pattern to be measured and edge reference data which is used as reference to detect the edge of the pattern within the pattern images (“The digital signal S2 is fed to an image processing processor 110 which performs image processing such as differential processing of an image and extraction of characteristic quantities, and sends the results to a control computer 111.”, column 5, line 4. It is inherent that since the disclosed invention is performed on a computer as in the reference given, the computer must contain some form of memory to store all images being acquired and/or used by the disclosed invention. As disclosed in FIG. 11, the plurality of pattern images is image set 1101 and the edge reference data is image set 1102. It must be noted that the images contain patterns as cited: “A charged particle beam apparatus such as a scanning electron microscope is suitable for measuring or observing patterns formed on a semiconductor wafer, which has been becoming finer.”, column 1, line 12.) and is configured of a plurality of pixels that are disposed so as to have an intensity gradient (“The figure illustrates an example in which pixel values from a Sobel filter are set as in-focus evaluation references. Like image differential, the Sobel filter is used to extract edge information of an image, and when a pixel value processed by a Sobel filter is large, this means that changes in pixel values around the pixel are large.”, column 6, line 61. It is well known to one of ordinary skill in the art that a Sobel filter is a discrete differentiation operator, computing an approximation of the gradient of the image intensity function.), the pattern images being obtained by an external imaging device at different focal distances

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("Numeral 1101 indicates a plurality of images captured by changing a focus, and 1102 indicates images obtained by processing each image 1101 by use of a Sobel filter.", column 7, line 1);

a calculator which scans the pattern image with said edge reference data, detects edge points of the pattern (The Sobel filter creating image set 1102 as mentioned above.), and also calculates a characteristic quantity that expresses a correlation between said edge reference data and the detected edge points of the pattern ("Pixels Sg1 through Sg5 at same coordinates in the plurality of images 1102 registered in the frame memories are compared, and of those pixels, a pixel of the largest value is extracted. Supposing that the pixel of the largest value is Sg2, a pixel value g2 of the original image of the pixel Sg2 is projected to a pixel at same coordinates in the composite image. A composite image 1103 is acquired by repeating this process for all coordinates of the image to select pixels of largest values, and arranging them to form a two-dimensional image.", column 7, line 6. The characteristic quantity is the equation given in FIG. 11, $\max(Sg1, Sg2, Sg3, Sg4, Sg5) = Sgx$ where Sgx is any one of the Sobel filter images. This quantity expresses a correlation between the edge reference data 1102 and the detected edge points of the pattern image 1101, since they are equal.);

a determinator which determines an in-focus state that expresses the degree to which the focal position at which each pattern image is obtained conforms to a desired pattern edge, based on the calculated characteristic quantity (The determinator is the full conditional operator given in the equation from FIG. 11. For example,

if $\max(Sg1, Sg2, Sg3, Sg4, Sg5) = Sg2$,

then g2 of original image is projected to the pixel of the composite image

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and is properly based upon the calculated characteristic quantity. Sg2 in this case has been determined to be the in-focus state of that particular pixel when creating the composite image.

“Then, in-focus portions can be extracted from each image so as to produce a composite image, which is a two-dimensional image focusing on all surfaces of the sample. These two images are registered in, for example, two frame memories.”, column 6, line 11.)

an image selector which selects the pattern image that conforms to measurement of the pattern from a plurality of the pattern images, in accordance with the determination result of said in-focus state determinator (FIG. 11 discloses the image selector with the example given where a pixel of image g2 is projected to the pixel of the composite image as defined by a vertical arrow. In essence, the determinator and image selector perform the same function as disclosed by Takane.), Takane does not teach a measurer which processes the selected pattern image to measure the pattern.

Gleason discloses a context-based automated defect classification system using multiple morphological masks (“It is an object of the invention to provide an automated semiconductor wafer defect classification system that classifies defects based on a combination of their location with respect to process layers of the semiconductor wafer and the defect characteristics.”, column 1, line 45) that teaches a measurer which processes the selected pattern image to measure the pattern (“The next component of the defect feature-based classifier 36 is the defect feature selector 32. It takes as its input the list of defect features 34, and pares that list down into a selected set of features 35. The defect feature selector 32 pares down the feature list 34 by accessing the knowledge base 23 and retrieving a list of existing discriminatory features for the

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current semiconductor device under inspection. This list of discriminatory defect features 34 is then passed on to the defect classifier 33.”, column 5, line 1.).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate into the pattern measuring apparatus of Takane the measurer of Gleason to process the selected pattern image of Takane to measure the pattern as taught by Gleason so that “...the usefulness of each individual feature for a given situation is determined...”, Gleason, column 9, line 6.

Regarding **claim 2**, Takane discloses wherein said external imaging device includes an optical system which is capable of adjusting focal position thereof within a range defined by an integer multiple of a predetermined step width from a predetermined initial value (“FIG. 2 is a graph showing changes in a focus evaluation value as electron lens conditions are changed;”, column 2, line 66. m As shown in FIG. 2, the changes in focus (exciting current of electron lens) are shown from 0 to 20, which are integer multiples of a predetermined step width (unit 1) from a predetermined initial value (unit 0). The electron microscope disclosed can adjust its focal position thereof within this range.); and the plurality of the pattern images are pattern images that have been obtained by imaging at each of focal positions calculated by adding integral multiples of the step width to said initial value (Each focus evaluation taken from FIG. 2 is from an integer multiple of the unit 1, and these are applied to the current embodiment as follows: “FIG. 11 is a schematic diagram showing a composing process according to the present invention. The figure illustrates an example in which pixel values from a Sobel filter are set as in-focus evaluation references.”, column 6, line 60.).

Regarding **claim 4**, while Takane discloses wherein the image selector selects a plurality of pattern images in accordance with the determination results of the in-focus state determinator (It has been assumed for examination purposes that a “plurality” is the largest share of something, which may or may not be considered a majority. The equation as disclosed in FIG. 11 requires the operation of “maximum” from a set of pixels in separate images. It is well known to one of ordinary skill in the art that the maximum can only be one pixel, and the definition of majority selected holds. In fact, the definition of majority holds again when there exists more than one pixel with the maximum value - in essence all of these pixels will be selected (the majority) since their value is maximum.); and

said pattern measuring apparatus further comprises an image processor which performs alignment processing between the selected plurality of pattern images and performs image processing to combine the selected pattern images (refer to references cited in claim 1), Takane does not teach the measurer measures the pattern on the basis of the combined pattern images.

Gleason discloses a context-based automated defect classification system using multiple morphological masks (“It is an object of the invention to provide an automated semiconductor wafer defect classification system that classifies defects based on a combination of their location with respect to process layers of the semiconductor wafer and the defect characteristics.”, column 1, line 45) that teaches a measurer measuring the pattern on the basis the pattern images (“The next component of the defect feature-based classifier 36 is the defect feature selector 32. It takes as its input the list of defect features 34, and pares that list down into a selected set of features 35. The defect feature selector 32 pares down the feature list 34 by accessing the

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knowledge base 23 and retrieving a list of existing discriminatory features for the current semiconductor device under inspection. This list of discriminatory defect features 34 is then passed on to the defect classifier 33.”, column 5, line 1.).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate into the pattern measuring apparatus of Takane the measurer measuring the pattern on the basis of the pattern images (of which is an image of the combined images as disclosed by Takane) as taught by Gleason so that “...the usefulness of each individual feature for a given situation is determined...”, Gleason, column 9, line 6.

Regarding **claim 5**, while the combination between Takane and Gleason disclose the pattern measuring apparatus according to claim 1, the combination does not teach wherein only edge points of the pattern which have been detected from previously processed pattern images and which are within a predetermined range are scanned with said edge reference data.

Gleason discloses a context-based automated defect classification system using multiple morphological masks (“It is an object of the invention to provide an automated semiconductor wafer defect classification system that classifies defects based on a combination of their location with respect to process layers of the semiconductor wafer and the defect characteristics.”, column 1, line 45) that teaches wherein only edge points of the pattern which have been detected from previously processed pattern images (“Next, in the layer feature selector 17, columns of features from the table 19 are selected using information stored in the knowledge database 23. The stored information is information that had been previously generated in an off-line training and analysis procedure. The layer feature selector 17 then performs statistical analysis on the

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training features, and each feature is ranked based on its ability to discriminate between possible classes. The information in the database 23 is considered a recipe generated for a specific set of operating conditions, e.g., wafer size, processing step, geometry. The new list of features 20 that is generated from this selection is a subset, or possibly all, of the original features 19.”, column 6, line 25.) and which are within a predetermined range (“FIG. 3 shows the background layer segmenter 13 in more detail. It includes a difference-of-Gaussians edge detector 47 which carries out edge extraction using a difference-of-Gaussians method; an excess colorspace converter 48 which transforms the intensity values of the reference image; and a continuous region labeler 49 which segments the regions based on edge boundaries, image intensity measurements, adaptive thresholding, and finally a morphological closing process that results in the segmented reference image 14.”, column , line wherein the edge detector uses a threshold (predetermined range) to create layers that are then considered for the knowledge database 23 to be compared with later if accepted into the knowledge database 23.) are scanned with said edge reference data (Scanning for the data already in the knowledge database 23 and the image data currently being compared is considered scanning “with” each other.).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to incorporate into the pattern measuring apparatus of Takene wherein only edge points of the pattern which have been detected from previously processed pattern images so for creating and which are within a predetermined range are scanned with the edge reference data as taught by Gleason to create “...a recipe generated for a specific set of operating conditions...”, Gleason, column 6, line 33.

Regarding **claim 11**, while Takane discloses a method of measuring a method of measuring a pattern to be measured from a plurality of pattern images obtained by capturing the pattern by an imaging device at different focal positions (refer to references cited in claim 1), said pattern measuring method comprising:

detecting edge points of a pattern to be measured by scanning the pattern with edge reference data which is used as reference to detect the edges of the pattern within pattern images (refer to references cited in claim 1) and which is configured of a plurality of pixels that are disposed so as to have an intensity gradient (refer to references cited in claim 1), and also calculating a characteristic quantity which expresses a correlation between said edge reference data and the pattern, the edge points of which have been detected (refer to references cited in claim 1);

determining an in-focus state that expresses the degree to which the focal position at which each obtained pattern image is obtained conforms to a desired pattern edge, based on said characteristic quantity that has been calculated (refer to references cited in claim 1); and

selecting the pattern image which conforms to measurement of the pattern from a plurality of the pattern images, in accordance with the result of determining said in-focus state (refer to references cited in claim 1), Takane does not teach processing the selected pattern image to measure the pattern.

Gleason discloses a context-based automated defect classification system using multiple morphological masks (“It is an object of the invention to provide an automated semiconductor wafer defect classification system that classifies defects based on a combination of their location with respect to process layers of the semiconductor wafer and the defect characteristics.”,

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column 1, line 45) that teaches processing the selected pattern image to measure the pattern (“The next component of the defect feature-based classifier 36 is the defect feature selector 32. It takes as its input the list of defect features 34, and pares that list down into a selected set of features 35. The defect feature selector 32 pares down the feature list 34 by accessing the knowledge base 23 and retrieving a list of existing discriminatory features for the current semiconductor device under inspection. This list of discriminatory defect features 34 is then passed on to the defect classifier 33.”, column 5, line 1.).

It would have been obvious to one of ordinary skill in the art to processing the selected pattern image to measure the pattern (of which is an image of the combined images as disclosed by Takane) as taught by Gleason so that “...the usefulness of each individual feature for a given situation is determined...”, Gleason, column 9, line 6.

Regarding **claim 12**, claim 2 recites identical features as in claim 12. Thus, arguments equivalent to those presented above for claim 2 is equally applicable to claim 12.

Regarding **claim 14**, claim 4 recites identical features as in claim 14. Thus, arguments equivalent to those presented above for claim 4 is equally applicable to claim 14.

Regarding **claim 15**, claim 5 recites identical features as in claim 15. Thus, arguments equivalent to those presented above for claim 5 is equally applicable to claim 15.

Regarding **claim 17**, Takane discloses wherein the characteristic quantity is calculated by using a plurality of sets of the edge reference data (As described above, the characteristic quantity is the maximum equation in FIG. 11 which involves a plurality of sets of the edge

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reference data (Sobel filter images). A pixel from each edge reference data is inputted into the characteristic quantity.).

Regarding **claim 19**, claim 11 recites identical features as in the method of manufacturing of claim 19. Thus, arguments equivalent to those presented above for claim 11 is equally applicable to claim 19.

13. **Claims 3 and 13** are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination between Takane et al. (US 6,538,249) “first embodiment” and Gleason et al. (US 6,456,899 B1), in further view of Takane et al. (US 6,538,249) “eighth embodiment”.

Regarding **claim 3**, the combination between Takane “first embodiment” and Gleason disclose the pattern measuring apparatus according to claim 1, while Takane “first embodiment” further discloses

wherein said image selector selects a plurality of pattern images in accordance with the determination results of said in-focus state determinator (It has been assumed for examination purposes that a “plurality” is the largest share of something, which may or may not be considered a majority. The equation as disclosed in FIG. 11 requires the operation of “maximum” from a set of pixels in separate images. It is well known to one of ordinary skill in the art that the maximum can only be one pixel, and the definition of majority selected holds. In fact, the definition of majority holds again when there exists more than one pixel with the maximum

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value - in essence all of these pixels will be selected (the majority) since their value is maximum.);

said pattern measuring apparatus further comprises an image processor which performs superimposing in a single coordinate system the edge points of the pattern within the pattern images (refer to references cited in claim 1); and

said measurer measures the pattern on the basis of position coordinates of pattern edge points that have been superposed in said single coordinate system (refer to references cited in claim 1), however Takane "first embodiment" does not teach the pattern measuring apparatus further comprising an image processor which performs alignment processing among said selected plurality of pattern images.

Takane "eighth embodiment" teaches a pattern measuring apparatus further comprising an image processor which performs alignment processing among pattern images ("An optical microscope image acquired by magnifying the alignment pattern a few hundreds times is compared with an alignment pattern reference image registered in the memory unit 3015, and correct the stage position coordinates to exactly align the visual field of the optical microscope image with that of the reference image.", column 16, line 50).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to teach an image processor which performs alignment processing among pattern images as taught by Takane "eighth embodiment" "...to correct the position coordinate system on the X-Y stage and the pattern position coordinate system in the wafer.", Takane "eighth embodiment", column 16, line 48.

Regarding **claim 13**, claim 3 recites identical features as in claim 13. Thus, arguments equivalent to those presented above for claim 3 is equally applicable to claim 13.

14. **Claims 6 and 16** are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination between Takane et al. (US 6,538,249) “first embodiment” and Gleason et al. (US 6,456,899 B1), in further view of Takane et al. (US 6,538,249) “fourth embodiment”.

Regarding **claim 6**, the combination between Takane “first embodiment” and Gleason disclose the pattern measuring apparatus according to claim 1, and while the Takane “first embodiment” further discloses

said calculator classifies said edge points that have been detected into edge point groups for each of said edge lines, and calculates a characteristic quantity for each of said edge point groups that have been classified (The groups (referred to as “sections” by Takane) are those shown in FIG. 4 of the first embodiment of the invention (showing two in-focus groups). Refer to the references cited in claim 1. The calculator classifies every pixel of the image with the maximum function, thus the calculator naturally classifies edge points that have been detected into edge point groups for each of the edge lines, and further calculates a characteristic quantity for each of the edge point groups that have been classified.); and

said determinator determines the in-focus state of the pattern image for each of said edge point groups that have been classified (Refer to the references cited in claim 1. The determinator determines every pixel of the image with the full conditional maximum function, thus the determinator naturally determines the in-focus state of the pattern image for each of said edge

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point groups that have been classified.), the combination does not teach wherein the pattern has a plurality of edge lines (Takane “first embodiment”, FIG. 4 discloses a “hole” of the “first embodiment” which only has one edge line – the circle itself).

Takane “fourth embodiment” teaches a pattern measuring apparatus further comprising wherein the pattern has a plurality of edge lines (“ FIG. 9 shows indication examples for displaying composite images on a real time basis according to the present invention.”, column 9, line 60. The pattern shown in FIG. 9 are holes, each with two edge lines and hence a plurality of edge lines.)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to teach the pattern having a plurality of edge lines as taught by Takane “fourth embodiment”, to differentiate a plurality of sections of the pattern to be further processed by the disclosed invention.

Regarding **claim 16**, claim 6 recites identical features as in claim 16. Thus, arguments equivalent to those presented above for claim 6 is equally applicable to claim 16.

15. **Claims 7, 8, 10, 18, and 20** are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination between Takane et al. (US 6,538,249) “first embodiment” and Gleason et al. (US 6,456,899 B1), in further view of Takane et al. (US 6,538,249) “eleventh embodiment”.

Regarding **claim 7**, while Takane “first embodiment” discloses a pattern measuring apparatus which is connectable to an external imaging device and which inspects a pattern to be

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measured on the basis of a pattern image supplied from the external imaging device (“A signal S1 from the detector 103 is input to an AD converter 107, which converts the signal into a digital signal S2. “, column 5, line 1 in combination with FIG. 1.), the external imaging device capturing an image of the pattern to be measured with an optical system (The optical system is disclosed in FIG. 1: “In FIG. 1, reference numerals 101 and 102 denote a sample stage and a sample to be imaged on the sample stage, respectively; 104 denotes a cathode; 105 represents a scanning coil; 106 represents an electron lens; 108 denotes a scanning coil control circuit; and 109 denotes a lens control circuit.”, column 4, line 47), a focal position of the optical system being adjustable with respect to the pattern by an integer multiple of a predetermined step width from a predetermined initial value (refer to references cited in claim 2), said pattern measuring apparatus comprising:

a storage device which stores edge reference data which is used as reference to detect the edge of the pattern within pattern images and which is configured of a plurality of pixels that are disposed so as to have an intensity gradient (refer to references cited in claim 1);

a characteristic quantity calculator which scans each pattern image with said edge reference data, detects edge points of the pattern to be measured, and also calculates a characteristic quantity that expresses a correlation between the detected pattern and said edge reference data (refer to references cited in claim 1); and

a determinator which determines an in-focus state that expresses the degree to which the focal position at which each pattern image is obtained conforms to a desired pattern edge, based on said characteristic quantity that has been calculated (refer to references cited in claim 1),
Takane “first embodiment” does not teach

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- (i) a focal-position controller which generates and outputs control signals to change the focal position of the optical system of the external imaging device if said determinator has determined that the focal position at the time of capture of the pattern image does not conform to said desired pattern edge and
- (ii) a measurer which operates to process the pattern image to measure the pattern if said determinator has determined that the focal position at the time of capture of the pattern image conforms to said desired pattern edge.

Gleason discloses a context-based automated defect classification system using multiple morphological masks (“It is an object of the invention to provide an automated semiconductor wafer defect classification system that classifies defects based on a combination of their location with respect to process layers of the semiconductor wafer and the defect characteristics.”, column 1, line 45) that teaches a measurer which operates to process the pattern image to measure the pattern if the determinator has determined that the focal position at the time of capture of the pattern image conforms to the desired pattern edge (“The next component of the defect feature-based classifier 36 is the defect feature selector 32. It takes as its input the list of defect features 34, and pares that list down into a selected set of features 35. The defect feature selector 32 pares down the feature list 34 by accessing the knowledge base 23 and retrieving a list of existing discriminatory features for the current semiconductor device under inspection. This list of discriminatory defect features 34 is then passed on to the defect classifier 33.”, column 5, line 1. The determinator as disclosed by Takane “first embodiment” will always determine that each pattern image obtained conforms to a desired pattern edge, based on said

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characteristic quantity that has been calculated since a maximum pixel from one of the Sobel filter images will always be calculated every time.).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to processing the selected pattern image to measure the pattern (of which is an image of the combined images as disclosed by Takane “first embodiment”) as taught by Gleason so that “...the usefulness of each individual feature for a given situation is determined...”, Gleason, column 9, line 6.

The combination between Takane “first embodiment” and Gleason disclose the pattern measuring apparatus described above, however the combination does not teach a focal-position controller which generates and outputs control signals to change the focal position of the optical system of the external imaging device if said determinator has determined that the focal position at the time of capture of the pattern image does not conform to said desired pattern edge.

Takane “eleventh embodiment” teaches a focal-position controller which generates and outputs control signals to change the focal position of the optical system of the external imaging device if said determinator has determined that the focal position at the time of capture of the pattern image does not conform to the desired pattern edge (“A maximum value storage means 4410 currently stores a maximum signal change amount value 4411 calculated up to the last image. A maximum value calculating means 4420 compares the maximum signal change amount value 4411 calculated up to the last image against a signal change amount 4321 of the current image, and selects the larger one as a maximum signal change amount value 4342 for up to the current image to update the maximum value stored in the maximum value storage means 4410

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with the selected value. A subtracting means 4430, on the other hand, calculates the difference between the maximum signal change amount value 4411 calculated up to the last image and the signal change amount 4321 of the current image, and a binarizing means 4440 determines whether the difference is larger than zero. That is, when the signal change amount 4321 is denoted as f and the maximum signal change amount value 4411 calculated up to the last image is denoted as f_{max} and composition information 4341 is represented as g ,

$$\text{if } f > f_{max}, g = 1$$
$$\text{if } f < f_{max}, g = 0$$

Therefore, when the signal change amount 4321 is larger than the maximum signal change amount value 4411 calculated up to the last image, $g=1$. That is, when a pixel of the current image should be selected as that for a composite image, its composition information g is set to 1.”, column 20, line 60.

F_{max} relates to that disclosed in FIG. 2 which is the maximum value of the focus evaluation. “Here, differential values between pixels or the like are used as focus evaluation values.”, column 5, line 26 – therefore edge pixels are being compared to determine F_{max} and it is well known to one of ordinary skill in the art that differential values between pixels involves intensity gradient and edge detection using a Sobel filter to generate the Sobel filter images.).

It would have been obvious to one of ordinary skill in the art to disclose a focal-position controller which generates and outputs control signals to change the focal position of the optical system of the external imaging device if said determinator has determined that the focal position at the time of capture of the pattern image does not conform to said desired pattern edge as

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taught by Tanake “eleventh embodiment” for “...focus determination...”, Tanake “eleventh embodiment”, column 20, line 60.

Regarding **claim 8**, claim 5 Takane “first embodiment” recites identical features as in claim 8. Thus, arguments equivalent to those presented above for claim 5 Takane “first embodiment” is equally applicable to claim 8.

Regarding **claim 10**, Takane “first embodiment” discloses wherein the characteristic quantity is calculated by using a plurality of sets of the edge reference data (As described above, the characteristic quantity is the maximum equation in FIG. 11 which involves a plurality of sets of the edge reference data (Sobel filter images). A pixel from each edge reference data is inputted into the characteristic quantity.).

Regarding **claim 18**, while Takane “first embodiment” discloses a method of measuring a pattern based on an image of a pattern to be measured which is obtained by an imaging device which captures the pattern to be measured (“A signal S1 from the detector 103 is input to an AD converter 107, which converts the signal into a digital signal S2. “, column 5, line 1 in combination with FIG. 1.) and includes an optical system (The optical system is disclosed in FIG. 1: “In FIG. 1, reference numerals 101 and 102 denote a sample stage and a sample to be imaged on the sample stage, respectively; 104 denotes a cathode; 105 represents a scanning coil; 106 represents an electron lens; 108 denotes a scanning coil control circuit; and 109 denotes a lens control circuit.”, column 4, line 47) thereof being adjustable with respect to the pattern by an

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integer multiple of a predetermined step width from an initial value (refer to references cited in claim 2), said method comprising:

detecting edge points of a pattern to be measured by scanning an image of the pattern with edge reference data which is used as reference to detect the edge points of the pattern (refer to references cited in claim 1) and which is configured of a plurality of pixels that are disposed so as to have an intensity gradient (refer to references cited in claim 1), and calculating a characteristic quantity which expresses a correlation between said edge reference data and the pattern, the edge of which has been detected (refer to references cited in claim 1); and

determining an in-focus state that expresses the degree to which the focal position at which each pattern image is obtained conforms to a desired pattern edge, based on said characteristic quantity that has been calculated (refer to references cited in claim 1), Takane “first embodiment” does not teach

- (i) obtaining a new image of the pattern at different focal positions until it is determined that it conforms to said desired pattern edge by varying the focal position of the optical system if it has been determined that the focal position at the time of capture of the pattern image does not conform to said desired pattern edge and
- (ii) processing the image of the pattern to measure the pattern if it has been determined that the focal position at the time of capture of the pattern image conforms to said desired pattern edge.

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Gleason discloses a context-based automated defect classification system using multiple morphological masks (“It is an object of the invention to provide an automated semiconductor wafer defect classification system that classifies defects based on a combination of their location with respect to process layers of the semiconductor wafer and the defect characteristics.”, column 1, line 45) that processes the image of the pattern to measure the pattern if it has been determined that the focal position at the time of capture of the pattern image conforms to the desired pattern edge (“The next component of the defect feature-based classifier 36 is the defect feature selector 32. It takes as its input the list of defect features 34, and pares that list down into a selected set of features 35. The defect feature selector 32 pares down the feature list 34 by accessing the knowledge base 23 and retrieving a list of existing discriminatory features for the current semiconductor device under inspection. This list of discriminatory defect features 34 is then passed on to the defect classifier 33.”, column 5, line 1. The determinator as disclosed by Takane “first embodiment” will always determine that each pattern image obtained conforms to a desired pattern edge, based on said characteristic quantity that has been calculated since a maximum pixel from one of the Sobel filter images will always be calculated every time.).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to process the image of the pattern to measure the pattern if it has been determined that the focal position at the time of capture of the pattern image conforms to the desired pattern edge (of which is an image of the combined images as disclosed by Takane “first embodiment”) as taught by Gleason so that “...the usefulness of each individual feature for a given situation is determined...”, Gleason, column 9, line 6.

The combination between Takane “first embodiment” and Gleason disclose the method of measuring a pattern as described above, however the combination does not teach obtaining a new image of the pattern at different focal positions until it is determined that it conforms to the desired pattern edge by varying the focal position of the optical system if it has been determined that the focal position at the time of capture of the pattern image does not conform to the desired pattern edge.

Takane “eleventh embodiment” teaches a focal-position controller which obtains a new image of the pattern at different focal positions until it is determined that it conforms to the desired pattern edge by varying the focal position of the optical system if it has been determined that the focal position at the time of capture of the pattern image does not conform to the desired pattern edge (“A maximum value storage means 4410 currently stores a maximum signal change amount value 4411 calculated up to the last image. A maximum value calculating means 4420 compares the maximum signal change amount value 4411 calculated up to the last image against a signal change amount 4321 of the current image, and selects the larger one as a maximum signal change amount value 4342 for up to the current image to update the maximum value stored in the maximum value storage means 4410 with the selected value. A subtracting means 4430, on the other hand, calculates the difference between the maximum signal change amount value 4411 calculated up to the last image and the signal change amount 4321 of the current image, and a binarizing means 4440 determines whether the difference is larger than zero. That is, when the signal change amount 4321 is denoted as f and the maximum signal change amount value 4411 calculated up to the last image is denoted as f_{\max} and composition information 4341 is represented as g ,

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if $f > f_{\max}$, $g=1$

if $f < f_{\max}$, $g=0$

Therefore, when the signal change amount 4321 is larger than the maximum signal change amount value 4411 calculated up to the last image, $g=1$. That is, when a pixel of the current image should be selected as that for a composite image, its composition information g is set to 1.”, column 20, line 60.

F_{\max} relates to that disclosed in FIG. 2 which is the maximum value of the focus evaluation. “Here, differential values between pixels or the like are used as focus evaluation values.”, column 5, line 26 – therefore edge pixels are being compared to determine F_{\max} and it is well known to one of ordinary skill in the art that differential values between pixels involves intensity gradient and edge detection using a Sobel filter to generate the Sobel filter images.).

It would have been obvious to one of ordinary skill in the art to disclose obtaining a new image of the pattern at different focal positions until it is determined that it conforms to the desired pattern edge by varying the focal position of the optical system if it has been determined that the focal position at the time of capture of the pattern image does not conform to the desired pattern edge as taught by Tanake “eleventh embodiment” for “...focus determination...”, Tanake “eleventh embodiment”, column 20, line 60.

Regarding **claim 20**, claim 18 recites identical features as in the method of manufacturing of claim 20. Thus, arguments equivalent to those presented above for claim 18 is equally applicable to claim 20.

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16. **Claim 9** is rejected under 35 U.S.C. 103(a) as being unpatentable over the combination between Takane et al. (US 6,538,249) “first embodiment”, Gleason et al. (US 6,456,899 B1), and Takane et al. (US 6,538,249) “eleventh embodiment” in further view of Takane et al. (US 6,538,249) “fourth embodiment”.

Regarding **claim 9**, while the combination between Takane “first embodiment”, Gleason, and Takane eleventh embodiment disclose the pattern measurement apparatus according to claim 7, and while the Takane “first embodiment” further discloses

said calculator classifies said edge points that have been detected into edge point groups for each of said edge lines, and calculates a characteristic quantity for each of said edge point groups that have been classified (The groups (referred to as “sections” by Takane) are those shown in FIG. 4 of the first embodiment of the invention (showing two in-focus groups). Refer to the references cited in claim 1. The calculator classifies every pixel of the image with the maximum function, thus the calculator naturally classifies edge points that have been detected into edge point groups for each of the edge lines, and further calculates a characteristic quantity for each of the edge point groups that have been classified.); and

said determinator determines the in-focus state of the pattern image for each of said edge point groups that have been classified (Refer to the references cited in claim 1. The determinator determines every pixel of the image with the full conditional maximum function, thus the determinator naturally determines the in-focus state of the pattern image for each of said edge point groups that have been classified.), the combination does not teach wherein the pattern has a

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plurality of edge lines (Takane “first embodiment”, FIG. 4 discloses a “hole” of the “first embodiment” which only has one edge line – the circle itself).

Takane “fourth embodiment” teaches a pattern measuring apparatus further comprising wherein the pattern has a plurality of edge lines (“ FIG. 9 shows indication examples for displaying composite images on a real time basis according to the present invention.”, column 9, line 60. The pattern shown in FIG. 9 are holes, each with two edge lines and hence a plurality of edge lines.)

It would have been obvious to one of ordinary skill in the art at the time the invention was made to teach the pattern having a plurality of edge lines as taught by Takane “fourth embodiment”, to differentiate a plurality of sections of the pattern to be further processed by the disclosed invention.

Conclusion

17. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David P. Rashid whose telephone number is (571) 270-1578. The examiner can normally be reached on 7:30 - 17:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Brian Werner can be reached on (571) 272-7401. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished

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DPR

David P Rashid
Examiner
Art Unit 2112



BRIAN WERNER
SUPERVISORY PATENT EXAMINER